DYKEMAGOSSETT PLLC

2723 SOUTH STATE STREET
SUITE 400
ANN ARBOR, MICHIGAN 48104

WWW.DYKEMA.COM

DATE:	August 10, 2004	**TOTAL PAGES INCLUDING COVER:**	**35**
SENDER'S NAME:	J. R. Drouillard	**LOCATION:**	Ann Arbor
SENDER'S E-MAIL:	jdrouillard@dykema.com		
SENDER'S PHONE:	(734) 214-7670	**SENDER'S FAX:**	(734) 214-7696

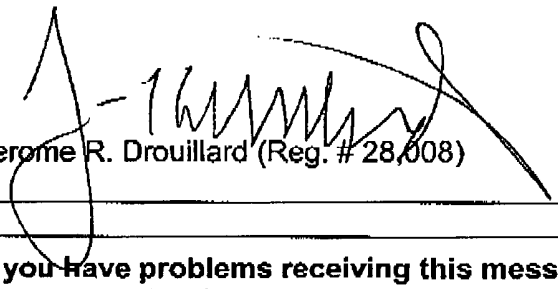
NAME	FAX NUMBER	CONFIRM NUMBER
TO: Commissioner of Patents U.S. Patent & Trademark Office	703-872-9306	

ADDITIONAL INFORMATION:

Re : S/N 10/064,997 filed 09/06/2002 – Appeal Brief

Attached please find the following:

1. Brief on Appeal – 3 copies (11 pages in each copy).
2. Fee Transmittal (PTO/SB/17) – 1 page



Jerome R. Drouillard (Reg. # 28,008)

If you have problems receiving this message, please call: (734) 214-7620

EMPLOYEE NO. 4325
CLIENT NO. 65244
MATTER NO. 146

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	Todd Allen Brown
Serial No.	10/064,997
Filed:	09/06/2002
For:	INDEPENDENT BRAKING AND CONTROLLABILITY CONTROL METHOD AND SYSTEM FOR A VEHICLE WITH REGENERATIVE BRAKING
Group Art Unit:	3683
Examiner:	Schwartz, Christopher P.
Attorney Docket No.:	201-0498 (81075470)

* * * * * * *

BRIEF ON APPEAL

Via central fax # (703) 872-9306

Mail Stop: Appeal Brief-Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

1. Real Party In Interest

The real party in interest to this appeal is the named assignee, Ford Motor Company, Dearborn, Michigan 48121.

2. Related Appeals and Interferences

There are no other known appeals or interferences which would have a bearing on, or be influenced by, the present appeal.

3. Status of Claims

Claims 1-26 were initially presented to the examiner for consideration. In response to an Office Action dated September 25, 2003, Claims 1 – 14 and 26 were cancelled, Claims 15, 17, 18 and 25 were amended, and Claims 27 – 31 were added. As a result of the Final Office Action dated april 1, 2004, a Request for Reconsideration was filed on June 1, 2004. Claims 15 – 25 and 27 – 31 remain in the case. They are reproduced in APPENDIX I.

4. Status of Amendments

A Request for Reconsideration was filed on June 1, 2004 in response to the Final Office Action of April 1, 2004. According to an Advisory Action dated July 29, 2004, this Request for Reconsideration was considered but was deemed by the Examiner to fail to place the application in condition for allowance.

5. Summary of the Invention

The present invention provides a method and system to control braking and improve controllability of a vehicle equipped with regenerative braking. The invention can provide regenerative braking while reducing understeer and oversteer while not significantly reducing energy recovery, even on low friction surfaces. The invention detects vehicle oversteer and understeer and correspondingly balances regenerative braking torque with conventional non-regenerative braking torque if controllability decreases.

In accordance with an important aspect of the present invention regenerative braking is provided to the wheels of at least one axle, either on a front or a rear axle. Also, mechanical

friction or other non-regenerative brakes of a type known in the art are connected to the wheels of at least one axle, with the regenerative braking and non-regenerative brakes being on different axles. The vehicle has a controller having the microprocessor hardware and software to receive and evaluate sensor input of brake position and wheel speed of each wheel and to activate a generator motor which varies non-regenerative and regenerative braking in optimum proportions among each non-regenerative braking wheel for maximum energy recovery. Further, the controller determines vehicle controllability based on at least one actual vehicle controllability value and at least one predetermined target value. The controller activates a generator motor that operates to reduce regenerative braking, while proportionally increasing non-regenerative braking in order to maintain the actual vehicle controllability value within the predetermined target value.

In accordance with a related aspect of the invention, the controller can be a simple proportional-integral-derivative feedback type controller.

The invention can reduce oversteer in vehicle configurations where the front axle wheels are steerable. In a preferred configuration the generator motor provides regenerative braking to the wheels on the rear axle, while the non-regenerative brakes are connected to the wheels on the front axle. The sensor input also includes data showing the steering angle in degrees left or right of dead center. Sensors also provide data related to lateral acceleration and yaw rate.

Vehicle controllability determinations, such as oversteer, can include measurement and feedback showing wheel longitudinal wheel slip ratio, tire slip angle, and yaw rate. Steering angle can be determined from steering wheel position, steerable wheel position or a time-filtered determination of steering angle. The present invention can also be configured to reduce understeer in front wheel drive vehicles. As regenerative braking is reduced, non-regenerative braking is increased.

For a rear wheel drive vehicle, where non-regenerative braking is provided on the front wheels, as regenerative braking in the rear is reduced and the vehicle is in a turn commanded

by the operator, the non-regenerative braking for the outside wheel of the turn is increased to reduce oversteer. Since non-regenerative braking is only increased on one wheel, a smaller reduction in the amount of regenerative braking is required. A similar strategy can be used for a front wheel drive vehicle. Here, as regenerative braking is reduced on the front wheels to reduce understeer, the strategy proportionally increases the non-regenerative braking on the rear wheel that is on the inside of the turn. These strategies maximize energy recovery.

Other objects and features of the present invention will become more apparent to persons skilled in the art to which the present invention pertains from the following description and claims taken in conjunction with the accompanying figures.

6. Issues to be Decided

Whether Claims 15, 16, 19, 20, 22 – 25 and 27 – 31 are properly rejected under 35 U.S.C. § 103(a) as being unpatentable over Kade et al. (U.S. Patent No. 5,522,859); and whether Claims 17, 18 and 21 are properly rejected under U.S.C. § 103(a) as being unpatentable over Kade et al. (U.S. Patent No. 5,522,859) in view of Tatara et al. (U.S. Patent No. 6,704,627).

7. Grouping of Claims

All claims stand or fall together.

8. Argument

Claims 15 – 25 and 27 – 31 are in the application. Claims 15, 16, 19, 20, 22 – 25 and 27 – 31 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Kade et al., U.S. Patent 5,522,859 ("Kade"). The Examiner states that Kade discloses a hybrid brake control system including regenerative and friction brakes, with friction brakes being applied on at least a first axle, and regenerative brakes being applied to a second axle. The Examiner continues with the statement that Kade discloses an ABS system which proportions the

friction/regenerative braking based on the amount of wheel slip. The Examiner admits that Kade lacks the teaching of reducing regenerative braking applied to one axle and increasing non-regenerative braking applied to a single wheel of a second axle to maintain vehicle controllability. Rather, the Examiner argues that it would have be obvious at the time the invention was made to have designed the system of Kade to reduce regenerative braking to the wheels of a first axle or increasing the friction braking to a single selected wheel of a second axle.

Kade's system is centered about ABS. As is well known, ABS reduces the brake power associated with a given wheel so as to prevent wheel slip. In other words, the braking available from the wheel is reduced. In contravention of this concept, Applicant's claimed invention sets forth a system for reducing regenerative braking by a wheel on a first axle, while increasing non-regenerative braking to a single selected wheel of a second axle. In other words, the braking is increased for a single wheel, rather than being decreased, as would be the case while employing an ABS system. This limitation is found in each of the independent claims of this case i.e. Claims 15, 25 and 27. As a result, Kade teaches away from the claimed invention, as set forth in each independent claim, and Claims 15, 16, 19, 20, 22 – 25 and 27 – 31 are therefore allowable over Kade and should be passed to issue over the Examiner's rejection.

Claims 17, 18 and 21 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Kade in view of Tatara et al., U.S. Patent 6,704,627 ("Tatara"). In this regard, the Examiner imports from Tatara the teaching of providing drive and regenerative braking forces to the rear wheels of a vehicle based upon a number of vehicle conditions including yaw rate and lateral acceleration. The Examiner argues that it would have been obvious to modify the brake system of Kade to incorporate yaw rate and lateral acceleration as control parameters. Regarding Claim 21, the Examiner argues that the choice of a particular axle for friction or non-regenerative braking would have been obvious. Finally, regarding Claim 21, the Examiner argues that the use of target and actual vehicle yaw rates would have been obvious.

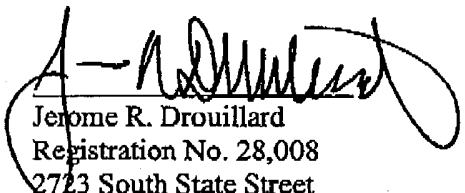
Applicant respectfully submits that neither Kade, nor Tatara, whether taken singly, or in combination with each other, either teach or suggest Applicant's claimed invention as set forth in Claims 17, 18 and 21 because as described previously, Kade teaches the use of ABS to reduce braking on an axle, rather than increasing braking on a single wheel after reducing regenerative braking on another axle, as claimed by Applicant. Moreover, Tatara is devoid of any notion of decreasing regenerative braking while increasing friction braking on a single wheel of a different axle. As a result, each of Claims 17, 18 and 21 should be passed to issue over the Examiner's rejection. Such action is earnestly solicited.

9. Conclusion

The Examiner's prior art rejection of Claims 15 – 25 and 27 – 31 should be reversed.

In accordance with 37 C.F.R. §1.192, this Appeal Brief is being filed in triplicate together with a Fee Transmittal for $330.00.

Respectfully submitted,
DYKEMA GOSSETT PLLC



Jerome R. Drouillard
Registration No. 28,008
2723 South State Street
Suite 400
Ann Arbor, MI 48104
(743) 214-7670

Dated: August 10, 2004

CERTIFICATE OF MAILING

I hereby certify that the enclosed Appeal Brief is being faxed to the Central Fax # (703) 872-9306 to Mail Stop Appeal Brief – Patents, Commissioner of Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on this 10 day of August 2004.

Daphne Poh

AA01\131078.1
ID\JRDR

APPENDIX I

IN THE CLAIMS:

Claim 1 – 14 (Cancelled)

Claim 15: A method to control braking and optimize controllability of a vehicle having a generator motor adapted to adjustably apply regenerative braking torque to wheels of a first axle and non-regenerative brakes connected to wheels of a second axle, comprising the steps of:

controlling the vehicle by sensing vehicle conditions including at least one of brake position, wheel speed of each wheel, and degree of steering angle deviation right or left of a straight ahead direction;

activating non-regenerative and regenerative braking in varying proportion independently among wheels of said first and second axles;

determining vehicle controllability based on comparison of at least one measured vehicle controllability value against at least one predetermined target value; and

reducing regenerative braking to the wheels of said first axle while increasing the non-regenerative braking to a single selected wheel of said second axle, to maintain the actual vehicle controllability value within the predetermined target value.

Claim 16: The method of Claim 15, wherein the step of controlling the vehicle comprises using a simple proportional-integral-derivative feedback controller.

Claim 17: The method of Claim 15, wherein:

wheels on a front axle are steerable;

the generator motor controls regenerative braking torque applied to the wheels on a rear axle;

non-regenerative brakes are connected to the wheels on the front axle;

the step of sensing vehicle conditions further comprises determining lateral acceleration and yaw rate of the vehicle; and

the step of reducing regenerative braking while increasing the non-regenerative braking to one wheel to maintain the actual vehicle controllability value within the predetermined target value comprises the step of increasing proportionally the non-regenerative brake torque applied to a front wheel which travels on an outside of a turn.

Claim 18: The method of Claim 15, wherein:

the wheels on the front axle are steerable;

the generator motor adjustably controls regenerative braking torque applied to the wheels on a front axle;

non-regenerative brakes are connected to the wheels on a rear axle;

the step of sensing vehicle conditions further comprises the step of determining lateral acceleration and yaw rate of the vehicle; and

the step of reducing regenerative braking while increasing the non-regenerative braking to one wheel to maintain the actual vehicle controllability value within a predetermined target value comprises the step of increasing proportionally the non-regenerative braking torque applied to a rear wheel traveling on an inside of a turn.

Claim 19: The method of Claim 15, wherein the vehicle controllability determination includes the step of measurement a longitudinal wheel slip ratio value.

Claim 20: The method of Claim 15, wherein the vehicle controllability determination includes the step of determining and comparing a target and actual vehicle tire slip angle.

Claim 21: The method of Claim 15, wherein the vehicle controllability determination includes the step of determining and comparing target and actual yaw rate.

Claim 22: The method of Claim 19, wherein the step of reducing regenerative braking is activated when the longitudinal wheel slip ratio value is greater than 10 percent.

Claim 23: The method of Claim 19, wherein the step of reducing regenerative braking is activated when the longitudinal wheel slip ratio value is greater than 5 percent.

Claim 24: The method of Claim 19, wherein the step of reducing regenerative braking is activated when the longitudinal wheel slip ratio value is greater than a value that is dependent on vehicle operating conditions.

Claim 25: Apparatus for continuously controlling braking and optimizing controllability of a vehicle, comprising:

a generator motor for providing regenerative braking torque to the wheels a first axle;
non-regenerative brakes being connected to the wheels of a second axle;
a controller adapted to operate said generator motor;
regenerative braking and non-regenerative braking being independently adjustably applied to wheels of said first and second axles; and
a control system embodied in the controller for directing the controller to sense vehicle conditions including brake position, wheel speed of each wheel, and degree of steering angle deviation right or left of a straight ahead orientation,
said control system being adapted to activate non-regenerative and regenerative braking in varying proportion independently among the wheels of said first axle and said second axle, and to determine vehicle controllability based on at least one measured vehicle controllability value and at least one predetermined target value, and, based on such determination, and to
reduce regenerative braking to all wheels of said first axle while increasing the non-regenerative braking to one wheel of said second axle to maintain the actual vehicle controllability value within the predetermined target value.

Claim 27: A system for controlling braking of a vehicle, comprising:

regenerative brakes connected to wheels of a first axle of said vehicle;
non-regenerative brakes connected to wheels of a second axle of said vehicle different from said first axle;
a plurality of sensors for measuring and providing electronic signals to monitor vehicle inputs, comprising at least a steering angle sensor and a brake pedal position sensor;
a controller adapted to continuously receive and process said signals; and
a generator motor activated by said controller for adjustably applying regenerative braking torque to each wheel of said first axle for maintaining a vehicle controllability value within a preselected target range, with said controller maintaining a vehicle controllability value by decreasing regenerative braking on all wheels of said first axle and by preferentially increasing non-regenerative braking on one wheel of said second axle.

Claim 28: A system according to Claim 27, wherein said first axle is a front axle of a vehicle and said second axle is a rear axle of a vehicle.

Claim 29: A system according to Claim 28, wherein said controller increases non-regenerative braking on only the inside wheel of said rear axle.

Claim 30: A system according to Claim 27, wherein said first axle is a rear axle of a vehicle and said second axle is a front axle of a vehicle.

Claim 31: A system according to Claim 30, wherein said controller increases non-regenerative braking on only the outside wheel of said front axle.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	Todd Allen Brown
Serial No.	10/064,997
Filed:	09/06/2002
For:	INDEPENDENT BRAKING AND CONTROLLABILITY CONTROL METHOD AND SYSTEM FOR A VEHICLE WITH REGENERATIVE BRAKING
Group Art Unit:	3683
Examiner:	Schwartz, Christopher P.
Attorney Docket No.:	201-0498 (81075470)

* * * * * * *

BRIEF ON APPEAL

Via central fax # (703) 872-9306

Mail Stop: Appeal Brief-Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

1. Real Party In Interest

The real party in interest to this appeal is the named assignee, Ford Motor Company, Dearborn, Michigan 48121.

2. Related Appeals and Interferences

There are no other known appeals or interferences which would have a bearing on, or be influenced by, the present appeal.

3. Status of Claims

Claims 1-26 were initially presented to the examiner for consideration. In response to an Office Action dated September 25, 2003, Claims 1 – 14 and 26 were cancelled, Claims 15, 17, 18 and 25 were amended, and Claims 27 – 31 were added. As a result of the Final Office Action dated april 1, 2004, a Request for Reconsideration was filed on June 1, 2004. Claims 15 – 25 and 27 – 31 remain in the case. They are reproduced in APPENDIX I.

4. Status of Amendments

A Request for Reconsideration was filed on June 1, 2004 in response to the Final Office Action of April 1, 2004. According to an Advisory Action dated July 29, 2004, this Request for Reconsideration was considered but was deemed by the Examiner to fail to place the application in condition for allowance.

5. Summary of the Invention

The present invention provides a method and system to control braking and improve controllability of a vehicle equipped with regenerative braking. The invention can provide regenerative braking while reducing understeer and oversteer while not significantly reducing energy recovery, even on low friction surfaces. The invention detects vehicle oversteer and understeer and correspondingly balances regenerative braking torque with conventional non-regenerative braking torque if controllability decreases.

In accordance with an important aspect of the present invention regenerative braking is provided to the wheels of at least one axle, either on a front or a rear axle. Also, mechanical

friction or other non-regenerative brakes of a type known in the art are connected to the wheels of at least one axle, with the regenerative braking and non-regenerative brakes being on different axles. The vehicle has a controller having the microprocessor hardware and software to receive and evaluate sensor input of brake position and wheel speed of each wheel and to activate a generator motor which varies non-regenerative and regenerative braking in optimum proportions among each non-regenerative braking wheel for maximum energy recovery. Further, the controller determines vehicle controllability based on at least one actual vehicle controllability value and at least one predetermined target value. The controller activates a generator motor that operates to reduce regenerative braking, while proportionally increasing non-regenerative braking in order to maintain the actual vehicle controllability value within the predetermined target value.

In accordance with a related aspect of the invention, the controller can be a simple proportional-integral-derivative feedback type controller.

The invention can reduce oversteer in vehicle configurations where the front axle wheels are steerable. In a preferred configuration the generator motor provides regenerative braking to the wheels on the rear axle, while the non-regenerative brakes are connected to the wheels on the front axle. The sensor input also includes data showing the steering angle in degrees left or right of dead center. Sensors also provide data related to lateral acceleration and yaw rate.

Vehicle controllability determinations, such as oversteer, can include measurement and feedback showing wheel longitudinal wheel slip ratio, tire slip angle, and yaw rate. Steering angle can be determined from steering wheel position, steerable wheel position or a time-filtered determination of steering angle. The present invention can also be configured to reduce understeer in front wheel drive vehicles. As regenerative braking is reduced, non-regenerative braking is increased.

For a rear wheel drive vehicle, where non-regenerative braking is provided on the front wheels, as regenerative braking in the rear is reduced and the vehicle is in a turn commanded

by the operator, the non-regenerative braking for the outside wheel of the turn is increased to reduce oversteer. Since non-regenerative braking is only increased on one wheel, a smaller reduction in the amount of regenerative braking is required. A similar strategy can be used for a front wheel drive vehicle. Here, as regenerative braking is reduced on the front wheels to reduce understeer, the strategy proportionally increases the non-regenerative braking on the rear wheel that is on the inside of the turn. These strategies maximize energy recovery.

Other objects and features of the present invention will become more apparent to persons skilled in the art to which the present invention pertains from the following description and claims taken in conjunction with the accompanying figures.

6. Issues to be Decided

Whether Claims 15, 16, 19, 20, 22 – 25 and 27 – 31 are properly rejected under 35 U.S.C. § 103(a) as being unpatentable over Kade et al. (U.S. Patent No. 5,522,859); and whether Claims 17, 18 and 21 are properly rejected under U.S.C. § 103(a) as being unpatentable over Kade et al. (U.S. Patent No. 5,522,859) in view of Tatara et al. (U.S. Patent No. 6,704,627).

7. Grouping of Claims

All claims stand or fall together.

8. Argument

Claims 15 – 25 and 27 – 31 are in the application. Claims 15, 16, 19, 20, 22 – 25 and 27 – 31 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Kade et al., U.S. Patent 5,522,859 ("Kade"). The Examiner states that Kade discloses a hybrid brake control system including regenerative and friction brakes, with friction brakes being applied on at least a first axle, and regenerative brakes being applied to a second axle. The Examiner continues with the statement that Kade discloses an ABS system which proportions the

friction/regenerative braking based on the amount of wheel slip. The Examiner admits that Kade lacks the teaching of reducing regenerative braking applied to one axle and increasing non-regenerative braking applied to a single wheel of a second axle to maintain vehicle controllability. Rather, the Examiner argues that it would have be obvious at the time the invention was made to have designed the system of Kade to reduce regenerative braking to the wheels of a first axle or increasing the friction braking to a single selected wheel of a second axle.

Kade's system is centered about ABS. As is well known, ABS reduces the brake power associated with a given wheel so as to prevent wheel slip. In other words, the braking available from the wheel is reduced. In contravention of this concept, Applicant's claimed invention sets forth a system for reducing regenerative braking by a wheel on a first axle, while increasing non-regenerative braking to a single selected wheel of a second axle. In other words, the braking is increased for a single wheel, rather than being decreased, as would be the case while employing an ABS system. This limitation is found in each of the independent claims of this case i.e. Claims 15, 25 and 27. As a result, Kade teaches away from the claimed invention, as set forth in each independent claim, and Claims 15, 16, 19, 20, 22 – 25 and 27 – 31 are therefore allowable over Kade and should be passed to issue over the Examiner's rejection.

Claims 17, 18 and 21 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Kade in view of Tatara et al., U.S. Patent 6,704,627 ("Tatara"). In this regard, the Examiner imports from Tatara the teaching of providing drive and regenerative braking forces to the rear wheels of a vehicle based upon a number of vehicle conditions including yaw rate and lateral acceleration. The Examiner argues that it would have been obvious to modify the brake system of Kade to incorporate yaw rate and lateral acceleration as control parameters. Regarding Claim 21, the Examiner argues that the choice of a particular axle for friction or non-regenerative braking would have been obvious. Finally, regarding Claim 21, the Examiner argues that the use of target and actual vehicle yaw rates would have been obvious.

Applicant respectfully submits that neither Kade, nor Tatara, whether taken singly, or in combination with each other, either teach or suggest Applicant's claimed invention as set forth in Claims 17, 18 and 21 because as described previously, Kade teaches the use of ABS to reduce braking on an axle, rather than increasing braking on a single wheel after reducing regenerative braking on another axle, as claimed by Applicant. Moreover, Tatara is devoid of any notion of decreasing regenerative braking while increasing friction braking on a single wheel of a different axle. As a result, each of Claims 17, 18 and 21 should be passed to issue over the Examiner's rejection. Such action is earnestly solicited.

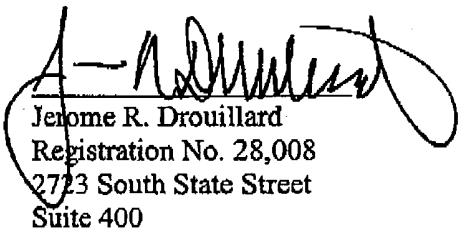
9. Conclusion

The Examiner's prior art rejection of Claims 15 – 25 and 27 – 31 should be reversed.

In accordance with 37 C.F.R. §1.192, this Appeal Brief is being filed in triplicate together with a Fee Transmittal for $330.00.

Respectfully submitted,

DYKEMA GOSSETT PLLC



Jerome R. Drouillard
Registration No. 28,008
2723 South State Street
Suite 400
Ann Arbor, MI 48104
(743) 214-7670

Dated: August 10, 2004

CERTIFICATE OF MAILING

I hereby certify that the enclosed Appeal Brief is being faxed to the Central Fax # (703) 872-9306 to Mail Stop Appeal Brief – Patents, Commissioner of Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on this 10 day of August 2004.

Daphne Poh

APPENDIX I

IN THE CLAIMS:

Claim 1 – 14 (Cancelled)

Claim 15: A method to control braking and optimize controllability of a vehicle having a generator motor adapted to adjustably apply regenerative braking torque to wheels of a first axle and non-regenerative brakes connected to wheels of a second axle, comprising the steps of:

controlling the vehicle by sensing vehicle conditions including at least one of brake position, wheel speed of each wheel, and degree of steering angle deviation right or left of a straight ahead direction;

activating non-regenerative and regenerative braking in varying proportion independently among wheels of said first and second axles;

determining vehicle controllability based on comparison of at least one measured vehicle controllability value against at least one predetermined target value; and

reducing regenerative braking to the wheels of said first axle while increasing the non-regenerative braking to a single selected wheel of said second axle, to maintain the actual vehicle controllability value within the predetermined target value.

Claim 16: The method of Claim 15, wherein the step of controlling the vehicle comprises using a simple proportional-integral-derivative feedback controller.

Claim 17: The method of Claim 15, wherein:

wheels on a front axle are steerable;

the generator motor controls regenerative braking torque applied to the wheels on a rear axle;

non-regenerative brakes are connected to the wheels on the front axle;

the step of sensing vehicle conditions further comprises determining lateral acceleration and yaw rate of the vehicle; and

the step of reducing regenerative braking while increasing the non-regenerative braking to one wheel to maintain the actual vehicle controllability value within the predetermined target value comprises the step of increasing proportionally the non-regenerative brake torque applied to a front wheel which travels on an outside of a turn.

Claim 18: The method of Claim 15, wherein:

the wheels on the front axle are steerable;

the generator motor adjustably controls regenerative braking torque applied to the wheels on a front axle;

non-regenerative brakes are connected to the wheels on a rear axle;

the step of sensing vehicle conditions further comprises the step of determining lateral acceleration and yaw rate of the vehicle; and

the step of reducing regenerative braking while increasing the non-regenerative braking to one wheel to maintain the actual vehicle controllability value within a predetermined target value comprises the step of increasing proportionally the non-regenerative braking torque applied to a rear wheel traveling on an inside of a turn.

Claim 19: The method of Claim 15, wherein the vehicle controllability determination includes the step of measurement a longitudinal wheel slip ratio value.

Claim 20: The method of Claim 15, wherein the vehicle controllability determination includes the step of determining and comparing a target and actual vehicle tire slip angle.

Claim 21: The method of Claim 15, wherein the vehicle controllability determination includes the step of determining and comparing target and actual yaw rate.

Claim 22: The method of Claim 19, wherein the step of reducing regenerative braking is activated when the longitudinal wheel slip ratio value is greater than 10 percent.

Claim 23: The method of Claim 19, wherein the step of reducing regenerative braking is activated when the longitudinal wheel slip ratio value is greater than 5 percent.

Claim 24: The method of Claim 19, wherein the step of reducing regenerative braking is activated when the longitudinal wheel slip ratio value is greater than a value that is dependent on vehicle operating conditions.

Claim 25: Apparatus for continuously controlling braking and optimizing controllability of a vehicle, comprising:

a generator motor for providing regenerative braking torque to the wheels a first axle;
non-regenerative brakes being connected to the wheels of a second axle;
a controller adapted to operate said generator motor;
regenerative braking and non-regenerative braking being independently adjustably applied to wheels of said first and second axles; and
a control system embodied in the controller for directing the controller to sense vehicle conditions including brake position, wheel speed of each wheel, and degree of steering angle deviation right or left of a straight ahead orientation,
said control system being adapted to activate non-regenerative and regenerative braking in varying proportion independently among the wheels of said first axle and said second axle, and to determine vehicle controllability based on at least one measured vehicle controllability value and at least one predetermined target value, and, based on such determination, and to
reduce regenerative braking to all wheels of said first axle while increasing the non-regenerative braking to one wheel of said second axle to maintain the actual vehicle controllability value within the predetermined target value.

Claim 27: A system for controlling braking of a vehicle, comprising:

regenerative brakes connected to wheels of a first axle of said vehicle;
non-regenerative brakes connected to wheels of a second axle of said vehicle different from said first axle;
a plurality of sensors for measuring and providing electronic signals to monitor vehicle inputs, comprising at least a steering angle sensor and a brake pedal position sensor;
a controller adapted to continuously receive and process said signals; and
a generator motor activated by said controller for adjustably applying regenerative braking torque to each wheel of said first axle for maintaining a vehicle controllability value within a preselected target range, with said controller maintaining a vehicle controllability value by decreasing regenerative braking on all wheels of said first axle and by preferentially increasing non-regenerative braking on one wheel of said second axle.

Claim 28: A system according to Claim 27, wherein said first axle is a front axle of a vehicle and said second axle is a rear axle of a vehicle.

Claim 29: A system according to Claim 28, wherein said controller increases non-regenerative braking on only the inside wheel of said rear axle.

Claim 30: A system according to Claim 27, wherein said first axle is a rear axle of a vehicle and said second axle is a front axle of a vehicle.

Claim 31: A system according to Claim 30, wherein said controller increases non-regenerative braking on only the outside wheel of said front axle.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	Todd Allen Brown
Serial No.	10/064,997
Filed:	09/06/2002
For:	INDEPENDENT BRAKING AND CONTROLLABILITY CONTROL METHOD AND SYSTEM FOR A VEHICLE WITH REGENERATIVE BRAKING
Group Art Unit:	3683
Examiner:	Schwartz, Christopher P.
Attorney Docket No.:	201-0498 (81075470)

* * * * * * *

BRIEF ON APPEAL

Via central fax # (703) 872-9306

Mail Stop: Appeal Brief-Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

1. Real Party In Interest

The real party in interest to this appeal is the named assignee, Ford Motor Company, Dearborn, Michigan 48121.

2. Related Appeals and Interferences

There are no other known appeals or interferences which would have a bearing on, or be influenced by, the present appeal.

3. Status of Claims

Claims 1-26 were initially presented to the examiner for consideration. In response to an Office Action dated September 25, 2003, Claims 1 – 14 and 26 were cancelled, Claims 15, 17, 18 and 25 were amended, and Claims 27 – 31 were added. As a result of the Final Office Action dated april 1, 2004, a Request for Reconsideration was filed on June 1, 2004. Claims 15 – 25 and 27 – 31 remain in the case. They are reproduced in APPENDIX I.

4. Status of Amendments

A Request for Reconsideration was filed on June 1, 2004 in response to the Final Office Action of April 1, 2004. According to an Advisory Action dated July 29, 2004, this Request for Reconsideration was considered but was deemed by the Examiner to fail to place the application in condition for allowance.

5. Summary of the Invention

The present invention provides a method and system to control braking and improve controllability of a vehicle equipped with regenerative braking. The invention can provide regenerative braking while reducing understeer and oversteer while not significantly reducing energy recovery, even on low friction surfaces. The invention detects vehicle oversteer and understeer and correspondingly balances regenerative braking torque with conventional non-regenerative braking torque if controllability decreases.

In accordance with an important aspect of the present invention regenerative braking is provided to the wheels of at least one axle, either on a front or a rear axle. Also, mechanical

friction or other non-regenerative brakes of a type known in the art are connected to the wheels of at least one axle, with the regenerative braking and non-regenerative brakes being on different axles. The vehicle has a controller having the microprocessor hardware and software to receive and evaluate sensor input of brake position and wheel speed of each wheel and to activate a generator motor which varies non-regenerative and regenerative braking in optimum proportions among each non-regenerative braking wheel for maximum energy recovery. Further, the controller determines vehicle controllability based on at least one actual vehicle controllability value and at least one predetermined target value. The controller activates a generator motor that operates to reduce regenerative braking, while proportionally increasing non-regenerative braking in order to maintain the actual vehicle controllability value within the predetermined target value.

In accordance with a related aspect of the invention, the controller can be a simple proportional-integral-derivative feedback type controller.

The invention can reduce oversteer in vehicle configurations where the front axle wheels are steerable. In a preferred configuration the generator motor provides regenerative braking to the wheels on the rear axle, while the non-regenerative brakes are connected to the wheels on the front axle. The sensor input also includes data showing the steering angle in degrees left or right of dead center. Sensors also provide data related to lateral acceleration and yaw rate.

Vehicle controllability determinations, such as oversteer, can include measurement and feedback showing wheel longitudinal wheel slip ratio, tire slip angle, and yaw rate. Steering angle can be determined from steering wheel position, steerable wheel position or a time-filtered determination of steering angle. The present invention can also be configured to reduce understeer in front wheel drive vehicles. As regenerative braking is reduced, non-regenerative braking is increased.

For a rear wheel drive vehicle, where non-regenerative braking is provided on the front wheels, as regenerative braking in the rear is reduced and the vehicle is in a turn commanded

by the operator, the non-regenerative braking for the outside wheel of the turn is increased to reduce oversteer. Since non-regenerative braking is only increased on one wheel, a smaller reduction in the amount of regenerative braking is required. A similar strategy can be used for a front wheel drive vehicle. Here, as regenerative braking is reduced on the front wheels to reduce understeer, the strategy proportionally increases the non-regenerative braking on the rear wheel that is on the inside of the turn. These strategies maximize energy recovery.

Other objects and features of the present invention will become more apparent to persons skilled in the art to which the present invention pertains from the following description and claims taken in conjunction with the accompanying figures.

6. Issues to be Decided

Whether Claims 15, 16, 19, 20, 22 – 25 and 27 – 31 are properly rejected under 35 U.S.C. § 103(a) as being unpatentable over Kade et al. (U.S. Patent No. 5,522,859); and whether Claims 17, 18 and 21 are properly rejected under U.S.C. § 103(a) as being unpatentable over Kade et al. (U.S. Patent No. 5,522,859) in view of Tatara et al. (U.S. Patent No. 6,704,627).

7. Grouping of Claims

All claims stand or fall together.

8. Argument

Claims 15 – 25 and 27 – 31 are in the application. Claims 15, 16, 19, 20, 22 – 25 and 27 – 31 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Kade et al., U.S. Patent 5,522,859 ("Kade"). The Examiner states that Kade discloses a hybrid brake control system including regenerative and friction brakes, with friction brakes being applied on at least a first axle, and regenerative brakes being applied to a second axle. The Examiner continues with the statement that Kade discloses an ABS system which proportions the

friction/regenerative braking based on the amount of wheel slip. The Examiner admits that Kade lacks the teaching of reducing regenerative braking applied to one axle and increasing non-regenerative braking applied to a single wheel of a second axle to maintain vehicle controllability. Rather, the Examiner argues that it would have be obvious at the time the invention was made to have designed the system of Kade to reduce regenerative braking to the wheels of a first axle or increasing the friction braking to a single selected wheel of a second axle.

Kade's system is centered about ABS. As is well known, ABS reduces the brake power associated with a given wheel so as to prevent wheel slip. In other words, the braking available from the wheel is reduced. In contravention of this concept, Applicant's claimed invention sets forth a system for reducing regenerative braking by a wheel on a first axle, while increasing non-regenerative braking to a single selected wheel of a second axle. In other words, the braking is increased for a single wheel, rather than being decreased, as would be the case while employing an ABS system. This limitation is found in each of the independent claims of this case i.e. Claims 15, 25 and 27. As a result, Kade teaches away from the claimed invention, as set forth in each independent claim, and Claims 15, 16, 19, 20, 22 – 25 and 27 – 31 are therefore allowable over Kade and should be passed to issue over the Examiner's rejection.

Claims 17, 18 and 21 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Kade in view of Tatara et al., U.S. Patent 6,704,627 ("Tatara"). In this regard, the Examiner imports from Tatara the teaching of providing drive and regenerative braking forces to the rear wheels of a vehicle based upon a number of vehicle conditions including yaw rate and lateral acceleration. The Examiner argues that it would have been obvious to modify the brake system of Kade to incorporate yaw rate and lateral acceleration as control parameters. Regarding Claim 21, the Examiner argues that the choice of a particular axle for friction or non-regenerative braking would have been obvious. Finally, regarding Claim 21, the Examiner argues that the use of target and actual vehicle yaw rates would have been obvious.

Applicant respectfully submits that neither Kade, nor Tatara, whether taken singly, or in combination with each other, either teach or suggest Applicant's claimed invention as set forth in Claims 17, 18 and 21 because as described previously, Kade teaches the use of ABS to reduce braking on an axle, rather than increasing braking on a single wheel after reducing regenerative braking on another axle, as claimed by Applicant. Moreover, Tatara is devoid of any notion of decreasing regenerative braking while increasing friction braking on a single wheel of a different axle. As a result, each of Claims 17, 18 and 21 should be passed to issue over the Examiner's rejection. Such action is earnestly solicited.

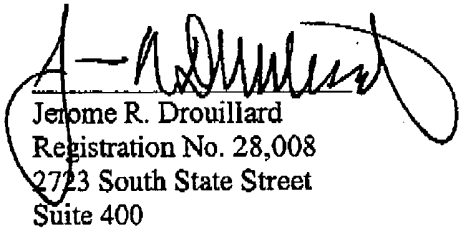
9. Conclusion

The Examiner's prior art rejection of Claims 15 – 25 and 27 – 31 should be reversed.

In accordance with 37 C.F.R. §1.192, this Appeal Brief is being filed in triplicate together with a Fee Transmittal for $330.00.

Respectfully submitted,

DYKEMA GOSSETT PLLC



Jerome R. Drouillard
Registration No. 28,008
2723 South State Street
Suite 400
Ann Arbor, MI 48104
(743) 214-7670

Dated: August 10, 2004

CERTIFICATE OF MAILING

I hereby certify that the enclosed Appeal Brief is being faxed to the Central Fax # (703) 872-9306 to Mail Stop Appeal Brief – Patents, Commissioner of Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on this 10 day of August 2004.

Daphne Poh

APPENDIX I

IN THE CLAIMS:

Claim 1 – 14 (Cancelled)

Claim 15: A method to control braking and optimize controllability of a vehicle having a generator motor adapted to adjustably apply regenerative braking torque to wheels of a first axle and non-regenerative brakes connected to wheels of a second axle, comprising the steps of:

controlling the vehicle by sensing vehicle conditions including at least one of brake position, wheel speed of each wheel, and degree of steering angle deviation right or left of a straight ahead direction;

activating non-regenerative and regenerative braking in varying proportion independently among wheels of said first and second axles;

determining vehicle controllability based on comparison of at least one measured vehicle controllability value against at least one predetermined target value; and

reducing regenerative braking to the wheels of said first axle while increasing the non-regenerative braking to a single selected wheel of said second axle, to maintain the actual vehicle controllability value within the predetermined target value.

Claim 16: The method of Claim 15, wherein the step of controlling the vehicle comprises using a simple proportional-integral-derivative feedback controller.

Claim 17: The method of Claim 15, wherein:

wheels on a front axle are steerable;

the generator motor controls regenerative braking torque applied to the wheels on a rear axle;

non-regenerative brakes are connected to the wheels on the front axle;

the step of sensing vehicle conditions further comprises determining lateral acceleration and yaw rate of the vehicle; and

the step of reducing regenerative braking while increasing the non-regenerative braking to one wheel to maintain the actual vehicle controllability value within the predetermined target value comprises the step of increasing proportionally the non-regenerative brake torque applied to a front wheel which travels on an outside of a turn.

Claim 18: The method of Claim 15, wherein:

the wheels on the front axle are steerable;

the generator motor adjustably controls regenerative braking torque applied to the wheels on a front axle;

non-regenerative brakes are connected to the wheels on a rear axle;

the step of sensing vehicle conditions further comprises the step of determining lateral acceleration and yaw rate of the vehicle; and

the step of reducing regenerative braking while increasing the non-regenerative braking to one wheel to maintain the actual vehicle controllability value within a predetermined target value comprises the step of increasing proportionally the non-regenerative braking torque applied to a rear wheel traveling on an inside of a turn.

Claim 19: The method of Claim 15, wherein the vehicle controllability determination includes the step of measurement a longitudinal wheel slip ratio value.

Claim 20: The method of Claim 15, wherein the vehicle controllability determination includes the step of determining and comparing a target and actual vehicle tire slip angle.

Claim 21: The method of Claim 15, wherein the vehicle controllability determination includes the step of determining and comparing target and actual yaw rate.

Claim 22: The method of Claim 19, wherein the step of reducing regenerative braking is activated when the longitudinal wheel slip ratio value is greater than 10 percent.

Claim 23: The method of Claim 19, wherein the step of reducing regenerative braking is activated when the longitudinal wheel slip ratio value is greater than 5 percent.

Claim 24: The method of Claim 19, wherein the step of reducing regenerative braking is activated when the longitudinal wheel slip ratio value is greater than a value that is dependent on vehicle operating conditions.

Claim 25: Apparatus for continuously controlling braking and optimizing controllability of a vehicle, comprising:

a generator motor for providing regenerative braking torque to the wheels a first axle;
non-regenerative brakes being connected to the wheels of a second axle;
a controller adapted to operate said generator motor;
regenerative braking and non-regenerative braking being independently adjustably applied to wheels of said first and second axles; and
a control system embodied in the controller for directing the controller to sense vehicle conditions including brake position, wheel speed of each wheel, and degree of steering angle deviation right or left of a straight ahead orientation,
said control system being adapted to activate non-regenerative and regenerative braking in varying proportion independently among the wheels of said first axle and said second axle, and to determine vehicle controllability based on at least one measured vehicle controllability value and at least one predetermined target value, and, based on such determination, and to
reduce regenerative braking to all wheels of said first axle while increasing the non-regenerative braking to one wheel of said second axle to maintain the actual vehicle controllability value within the predetermined target value.

Claim 27: A system for controlling braking of a vehicle, comprising:

regenerative brakes connected to wheels of a first axle of said vehicle;
non-regenerative brakes connected to wheels of a second axle of said vehicle different from said first axle;
a plurality of sensors for measuring and providing electronic signals to monitor vehicle inputs, comprising at least a steering angle sensor and a brake pedal position sensor;
a controller adapted to continuously receive and process said signals; and
a generator motor activated by said controller for adjustably applying regenerative braking torque to each wheel of said first axle for maintaining a vehicle controllability value within a preselected target range, with said controller maintaining a vehicle controllability value by decreasing regenerative braking on all wheels of said first axle and by preferentially increasing non-regenerative braking on one wheel of said second axle.

Claim 28: A system according to Claim 27, wherein said first axle is a front axle of a vehicle and said second axle is a rear axle of a vehicle.

Claim 29: A system according to Claim 28, wherein said controller increases non-regenerative braking on only the inside wheel of said rear axle.

Claim 30: A system according to Claim 27, wherein said first axle is a rear axle of a vehicle and said second axle is a front axle of a vehicle.

Claim 31: A system according to Claim 30, wherein said controller increases non-regenerative braking on only the outside wheel of said front axle.

PTO/SB/17 (10-03)
Approved for use through 07/31/2006. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

FEE TRANSMITTAL for FY 2004

Effective 10/01/2003. Patent fees are subject to annual revision.

☐ Applicant claims small entity status. See 37 CFR 1.27

TOTAL AMOUNT OF PAYMENT ($) 440.00

Complete if Known	
Application Number	10/064,997
Filing Date	09/06/2002
First Named Inventor	TODD ALLEN BROWN
Examiner Name	SCHWARTZ, CHRISTOPHER P.
Art Unit	3683
Attorney Docket No.	201-0498 (81075470)

METHOD OF PAYMENT *(check all that apply)*

☐ Check ☐ Credit card ☐ Money Order ☐ Other ☐ None

☒ Deposit Account:

Deposit Account Number: 06-1510

Deposit Account Name: FORD GLOBAL TECHNOLOGIES LLC

The Director is authorized to: *(check all that apply)*

☒ Charge fee(s) indicated below ☒ Credit any overpayments

☒ Charge any additional fee(s) or any underpayment of fee(s)

☐ Charge fee(s) indicated below, except for the filing fee to the above-identified deposit account.

FEE CALCULATION

1. BASIC FILING FEE

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
1001	770	2001	385	Utility filing fee	
1002	340	2002	170	Design filing fee	
1003	530	2003	265	Plant filing fee	
1004	770	2004	385	Reissue filing fee	
1005	160	2005	80	Provisional filing fee	

SUBTOTAL (1) ($)

2. EXTRA CLAIM FEES FOR UTILITY AND REISSUE

	Extra Claims		Fee from below	Fee Paid
Total Claims		-20** =		X =
Independent Claims		- 3** =		X =
Multiple Dependent				=

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description
1202	18	2202	9	Claims in excess of 20
1201	86	2201	43	Independent claims in excess of 3
1203	290	2203	145	Multiple dependent claim, if not paid
1204	86	2204	43	** Reissue independent claims over original patent
1205	18	2205	9	** Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) ($)

***or number previously paid, if greater; For Reissues, see above*

FEE CALCULATION (continued)

3. ADDITIONAL FEES

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
1051	130	2051	65	Surcharge - late filing fee or oath	
1052	50	2052	25	Surcharge - late provisional filing fee or cover sheet	
1053	130	1053	130	Non-English specification	
1812	2,520	1812	2,520	For filing a request for *ex parte* reexamination	
1804	920*	1804	920*	Requesting publication of SIR prior to Examiner action	
1805	1,840*	1805	1,840*	Requesting publication of SIR after Examiner action	
1251	110	2251	55	Extension for reply within first month	110
1252	420	2252	210	Extension for reply within second month	
1253	950	2253	475	Extension for reply within third month	
1254	1,480	2254	740	Extension for reply within fourth month	
1255	2,010	2255	1,005	Extension for reply within fifth month	
1401	330	2401	165	Notice of Appeal	
1402	330	2402	165	Filing a brief in support of an appeal	330
1403	290	2403	145	Request for oral hearing	
1451	1,510	1451	1,510	Petition to institute a public use proceeding	
1452	110	2452	55	Petition to revive - unavoidable	
1453	1,330	2453	665	Petition to revive - unintentional	
1501	1,330	2501	665	Utility issue fee (or reissue)	
1502	480	2502	240	Design issue fee	
1503	640	2503	320	Plant issue fee	
1460	130	1460	130	Petitions to the Commissioner	
1807	50	1807	50	Processing fee under 37 CFR 1.17(q)	
1806	180	1806	180	Submission of Information Disclosure Stmt	
8021	40	8021	40	Recording each patent assignment per property (times number of properties)	
1809	770	2809	385	Filing a submission after final rejection (37 CFR 1.129(a))	
1810	770	2810	385	For each additional invention to be examined (37 CFR 1.129(b))	
1801	770	2801	385	Request for Continued Examination (RCE)	
1802	900	1802	900	Request for expedited examination of a design application	

Other fee (specify) _____

*Reduced by Basic Filing Fee Paid SUBTOTAL (3) ($) 440.00

SUBMITTED BY				(Complete *if applicable*)	
Name (Print/Type)	JEROME R. DROUILLARD	Registration No. (Attorney/Agent)	28,008	Telephone	(734) 214-7670
Signature				Date	8/10/04

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.